

Electrical awareness- New procedures

JBC is launching a new electrical procedure according to corporate requirement , this procedure requires the training marital for non –electrical people to cover subjects related to Arc Flash hazards and other subjects

If you have completed successfully the electrical awatreness training and its tests before 22 Sept 2019. You are kindly requested to study the following slides, ask questions, and go to testing room, to complete the complementary tests to make sure you have completed above training requirements

What's the difference between the function of a breaker and overload



An overload device is designed to trip over a period of time once the current draw exceeds the max current the motor can safely handle, whereas a breaker is usually set to trip at a higher current, such as in the case of a short-circuit in the line.

Due to the fact that breakers trip because of short circuits, Once a breaker has tripped you cannot manually turn the circuit breaker back on until it has been determined that the equipment and circuit can be safely energized (OSHA 1910.334 b(2)). The repetitive manual reclosing of a circuit breaker is prohibited

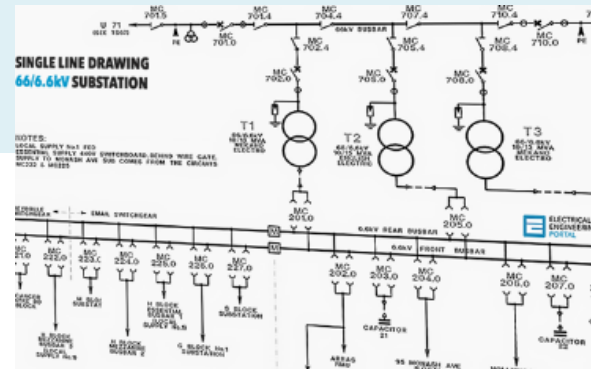
If you know it was on overload situation, you can reset a tripped breaker-only once. Each site may designate that only Electrically Qualified Personnel can reset breakers.

Management of Change in Electrical system

"Change" is any modification that is not a "replacement in kind."

Changes in Electrical components which might affect process safety or the safety of the electrical equipment similar but not limited to:

- Emergency shutdown system
- Controls (including monitoring devices and sensors, alarms and interlocks),
- equipment specifications,
- computer program revisions that can affect the safety of the operation,
- alarms and interlock set points outside of established safe operating limits or interlocks,



ALHILO High/Low Alarm	
Input	CurrentTemp
High-High Limit	300
High-High Alarm	C100
High Limit	HighCookTemp
High Alarm	C101
Low Limit	
Low Alarm	
Low-Low Limit	50
Low-Low Alarm	C102

Other high voltage hazards

Voltage Classification

- Voltage Classification: The following Voltage classifications shall be used by JBC for application of this standard. -

Low Voltage: – Below 1,000 Volts

Medium Voltage: – Is between $> 1,000$ Volts and 50,000 volts

High Voltage: Above 50 000 volts

Important: This classification does not say that low voltages is safer regarding Arc flash incidents. On the contrary, some European statistics say that most of arc flash incidents happens on low voltage systems

Arc Flash

- Arc flash is the passage of electrical current between two conductors through an ionized gas or vapor, usually air.
- arc flash -short circuit through the air (Lightning).

Arc Flash-Arc Blast

- In an arc flash incident, an enormous amount of concentrated radiant energy explodes outward from the source. This explosion is known as an ARC Blast, Which can damage a person's hearing. There is a high-intensity flash that can damage their eyesight and a superheated ball of gas that can severely burn a worker's body and melt metal



Arc Flash

Electrician Performs Repairs



Arc occurs



Arc Flash/Blast Occurs

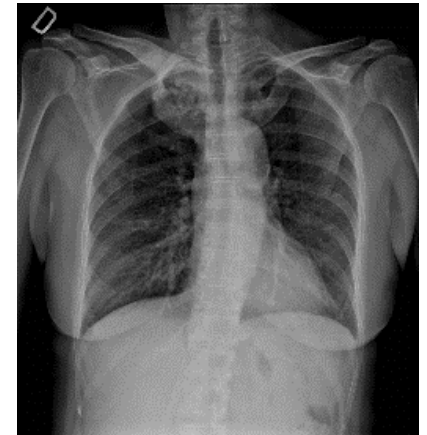


Arc Flash Injuries

- Electric shock
- Severe burns
- Blindness
- Blast injuries
 - Shrapnel wounds

Lung blast injuries: Arc blast can cause inhalation injuries, for example: Inhalation high temperature copper vapors, actually more than 100 toxic substances may be found in fumes

- Ruptured eardrums
- Pressure wave injuries



Arc blast at 2 feet	145 decibels
Jet engine at 200 feet	132 decibels
Pain threshold	130 decibels

Main causes of Arc Flash?

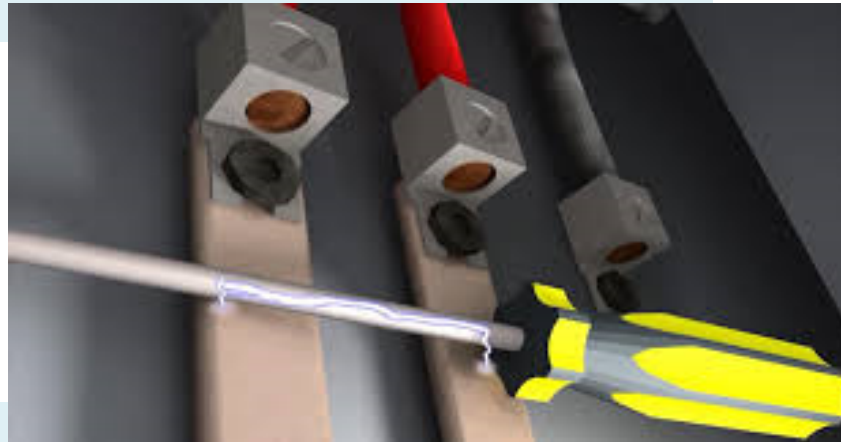
Condensation, Dust, water, impurities, contamination, corrosion, oil, and grease can also provide a starting route for the short circuit.

Animals Even animals or bugs can get into electrical devices and start an arc flash.

- An accidental slip of a tool, a loose part, or even your hand touching live parts can provide the start the current needs to jump from one cable to the next.

Loose connections in the electrical equipment, improper installation, and parts that break and fall are other possible triggers.

- Accidental touching
- Over-voltages across narrow gaps
- Failure of insulating materials
- Equipment failure



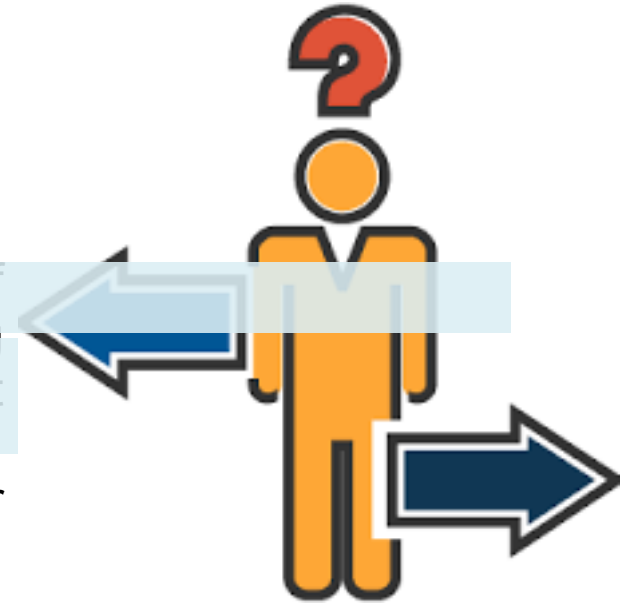
Tasks with potential Arc Flash

- Operating a disconnect switch or circuit breaker
- Inserting or removing a circuit breaker
- Opening an enclosure door
- Removing a cover (bolted or hinged)
- Testing for voltage



Human Errors

- A lot of arc flash incidents happened , were the result of human error, such as touching a test probe to the wrong surface, tools or accessories such as breaker shaft extensions slipped on live parts of the installation, forgotten tools, dangling unshielded secondary wiring, or a worker entering the wrong panel.



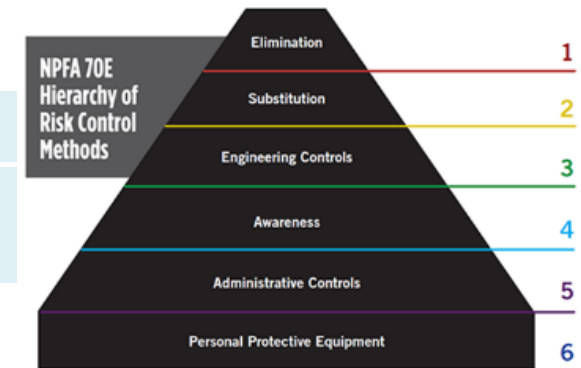
Some work activities such as voltage testing, impedance measurements, fault finding, and commissioning take place with energized conductors in close proximity, either because they are allowed exceptions or because the activity requires it. Even making the equipment safe to work can expose the worker to a hazard. Although internal arc faults are often caused by human mistakes or ignorance, switchgear designs do affect the probability of making mistakes or touching live parts.

Installation failures

- Insulation failures can increase the probability of arc faults as well, obviously due to improper installation, poor maintenance, moisture, whiskers, animals, or even normal wear and tear. Loss of insulating properties resulting from elevated temperatures can be caused by applying the equipment above its continuous rating or from improperly torqued or aligned contact joints. Another cause can be voids in insulation, which eventually lead to failure of the insulation when stressed at high voltages, or the presence of dust, contamination, or moisture on insulating surfaces. These conditions can lead to tracking across insulating surfaces, providing a path for conduction between two different potentials.

How to protect workers from Arc Flash

- No repair work will be done on live electrical parts with voltage rating above 50 volt without justification, review by an Electrically Qualified Person and an approved Energized Work Permit. Working on or near, except for diagnostics, live parts should be avoided whenever possible. De-energizing and properly locking and/or tagging out of the circuit are always preferred.
- Maintaining a distance from exposed live conductors coupled with adequate PPE is an effective means of minimizing the hazard when de-energizing is not feasible.
- Un-insulated metal objects (tools, keys, bracelets, metal watchbands, etc.) shall not be worn within the Limited Approach Boundary. Fiberglass ladders and insulated tools shall be used where there is a possibility of contacting energized components.
- An Energized Work Permit must be initiated by the equipment's owner. If the live electrical work will be done within an electrically classified area, a Hot Work permit must also be completed. The personal protective equipment designated on the permit should match the PPE for the task from the arc flash hazard label/ PPE Table



How to protect workers from Arc Flash

- In JBC: Only authorized and Qualified persons can work on exposed systems
- Qualified means: Electrical Technicians
- Authorized means: They have a signed energized work permit
- Operation personnel similar to operations supervisors, technicians are considered as unqualified/ un-authorized personnel for the responsibilities of this procedure
- Operation personnel can enter the MCC Rooms to only switch on/ off or LTT some equipment. On conditions the compartment of these MCCs are closed
- As normal operation of such MCC rooms, all compartments should be always closed. If someone observes an open compartment, he/she should not enter the MCC room and inform E/I department responsible persons

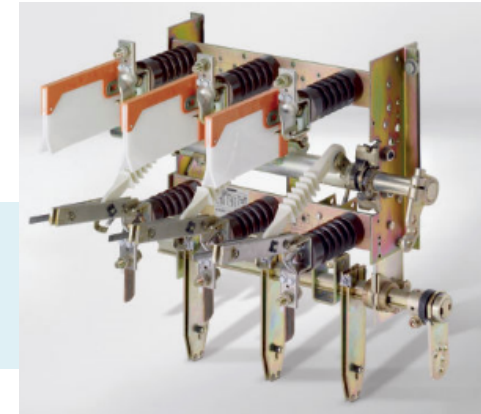


Workers should always be aware of their : Nature of task they are doing, Qualification and authorization, Labelling , (Boundary): Working distance exposed source , PPE, Level of authorization and training

(De-energize & verify)

Do not work on energized electrical circuits operating at 50 V or more.

An Electrically Safe Work Condition shall be achieved when performed in accordance with the procedures of 70E 120.2. These are the typical steps to obtain an Electrically Safe Work Condition:



- Determine and isolate all possible sources of electrical supply to the specific equipment.

- Wherever possible, visually verify that all blades of the disconnecting device are fully open or that the drawout type circuit breakers are withdrawn to the fully disconnected

Note: Disconnect switch blades should be confirmed open when accessible to insure a true open circuit. Switchgear Circuit Breakers can be withdrawn so that there is a physical air break insuring a true open circuit. It is NOT the intent here to unstab MCC Cells. If a task requires a true open circuit on a feeder originating from an MCC, the motor / feeder leads should be disconnected.

Establish an Electrically Safe Work Condition: (De-energize & verify)

1. Apply lockout / tagout devices in accordance with the documented and established policy (Albemarle LOTO procedure).



4. Where possibility of induced voltage or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Ensure grounding devices are rated for the available fault duty.

5. Verification with appropriate rated test equipment must be done assuming the parts are still live. Before and after each test, the test instrument must be verified as operational using a known electrical source.

Energized Work

If it is necessary to work on energized electrical circuits operating at 50 V or more.

Energized work is permitted when required to support a critical mission, prevent human injury, or protect property

In all instances of work on energized electrical circuits, workers must be qualified and authorized for energized line work and all required protective equipment and special tools must be available at the work site. Energized work permit should be issued and approved by plant manager

Examples

1. De-energizing introduces additional or increased hazards
 - Interruption of life support equipment
 - Cutting ventilation to a hazardous location
2. Infeasible due to equipment design or operational limitations
 - Voltage testing for diagnostics
 - Start up testing



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Energized Work



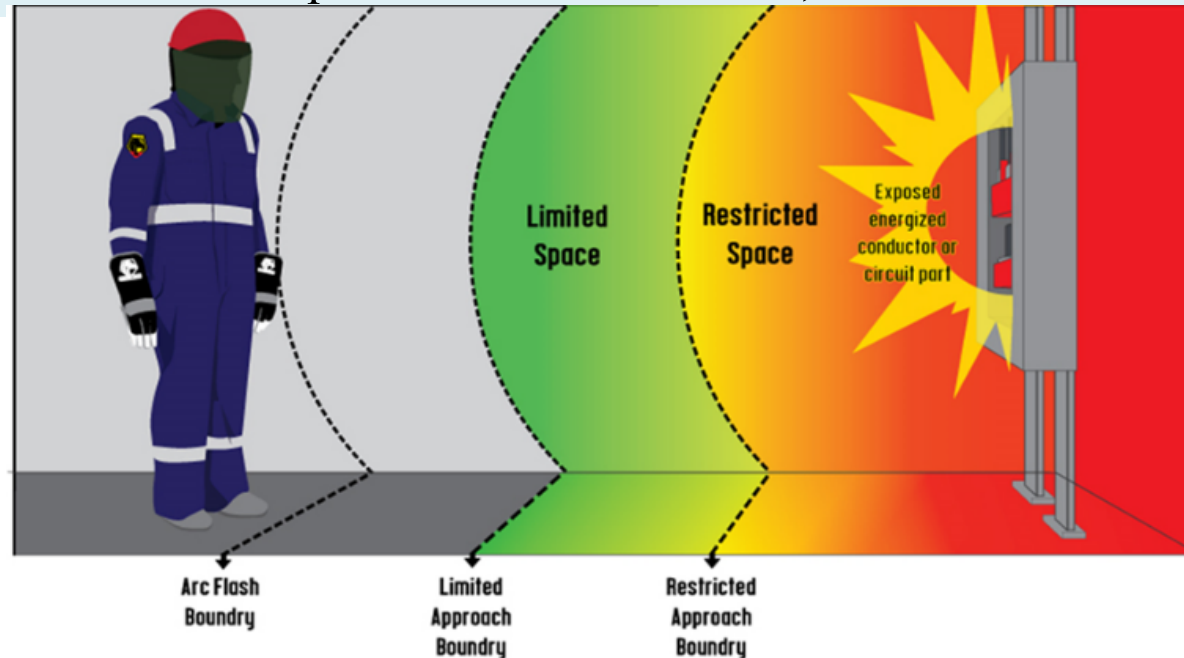
Energized Work on Equipment Exceeding 1000VAC is permitted only for a specific task that has been predefined in a Standard Maintenance Procedure with approved justification and risk review. Any energized work above 1000 volts must be performed by an employee or contractor that has received the proper training and certification for the specific task.

Work involving routine tasks such as voltage testing and troubleshooting requires a General Safe Work Permit. As soon as work extends beyond what is allowed in the predefined Standard Maintenance Procedure, an Energized Electrical Work Permit shall be required.

Understanding the arc flash boundary

The National Fire Protection Association (NFPA) recommends identifying two boundaries to define the safe working limits for personnel working in an area with shock hazards. Each area is associated with a level of training and PPE.

the incident energy increases rapidly as the distance decreases. When troubleshooting or any task where there is a potential for an arc flash,



The Arc Flash boundary

The arc flash boundary (AFB) is the minimum 'safe' distance from exposed energized conductors or circuit parts that has a potential for an arc fault. It is defined as the distance at which, in the event of an arc flash, a worker would be exposed to a thermal event with incident energy of 1.2 cal/cm² for 1.0 second. With this exposure, a worker may receive the onset of a second degree burn to exposed skin, typically the neck, face and hands. If it is necessary for workers to cross the arc flash boundary, and potentially be exposed to higher incident energies from any arc flash, they must be wearing appropriate personal protective equipment (PPE).

Limited Approach Boundary: For a person to cross the limited approach boundary and enter the limited space, a person should be (1) Qualified to perform the task
(2) Be able to identify the hazards and associated risks with the tasks to be performed.

Restricted Approach Boundary: For a QUALIFIED person to cross the restricted approach boundary and enter the restricted space a person should (1) Use a preapproved Standard Maintenance Procedure or have an approved Energized Electrical Work Permit
(2) Use personal protective equipment rated for the Voltage and Energy Level involved.
(3) Minimize the likelihood of bodily contact with exposed electrical conductors and circuit parts. (4) Use insulated tools and equipment.

RISK ASSESSMENT

Insure you are **AUTHORIZED** and **QUALIFIED** before beginning any task involving electrical equipment.

AUTHORIZED: All necessary work permits (General Safe Work Permit, Energized Electrical Work Permit [as required], etc.) have been completed.

QUALIFIED: Trained in the application of the Albemarle Electrical Safety Policy and NFPA_70E requirements specific to the task at hand.



When performing a risk assessment, it must be determined where to place safety barriers to limit access for unqualified persons.

Either the limited approach boundary or the arc flash boundary is used. So, for example, if the arc flash boundary is greater than the limited approach boundary then no unqualified person can be permitted to cross the arc flash boundary and even qualified workers must wear appropriate arc-resistant PPE.

Secure Workspace: Guard or Barricade the working Area w/ Red Tape & Tag.

Area should be at least the greater of: 1) Arc Flash Boundary or 2) - Limited Approach Boundary

Protective Clothing

Selection of Protective Clothing and Personal Protective Equipment must be performed during the Risk Assessment of Electrical Hazards. Required PPE is predefined in Standard Maintenance Procedures for specific tasks. For other work, a Risk Assessment considering the information provided on the Equipment Electrical Hazard Label and the task at hand must be done as part of the Energized Electrical Work Permit.

Incident Energy listed on the label is for the distance stated – the task at hand may involve working at a closer distance and thus higher rated PPE. Energized work should NOT be performed without proper review. You must be AUTHORIZED and QUALIFIED to perform Energized Electrical Work.

Everyday Work Clothing - Minimum Requirements: Long sleeve shirt, long pants, leather gloves (as needed), hardhat, safety glasses, ear plugs.

Arc flash hazard label


ANSI CLASSIFICATION
(Warning: A potentially hazardous situation, if not avoided, could result in serious injury or death).
Ref ANSI Z535 (OSHA Basis labeling on this standard).

ARC FLASH INFORMATION

SHOCK PROTECTION INFORMATION

BUS NAME

UPSTREAM PROTECTIVE DEVICE

		WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required			
2.1 cal/cm2	Incident Energy at	18 in	
25 in	Arc Flash Hazard Boundary		
480 VAC	Shock Hazard (when cover is open) - See Facility PPE Table		
42 in	Limited Approach Boundary		
12 in	Restricted Approach Boundary		
BUS: KM00-MCC-2A		09/16/2016	
PD: KM00-SGR-122-3A (Phase)		Normal Case	

ARC FLASH ENERGY AT DISTANCE STATED

ARC FLASH BOUNDARY Incident Energy at 1.2 cal/cm2 (Second Degree Burn Possible at this Distance)

NOMINAL SYSTEM VOLTAGE

CLOSEST APPROACH DISTANCE FOR AN "UNQUALIFIED" INDIVIDUAL

CLOSEST APPROACH DISTANCE FOR A "QUALIFIED" INDIVIDUAL WORK TASK MUST BE GUIDED BY

REVISION

BASIS OF CALCULATION (Operating State)

Secure Workspace: Guard or Barricade the working Area w/ Red Tape & Tag.
Area should be at least the greater of: 1) Arc Flash Boundary or 2) - Limited Approach Boundary

Rubber Insulating Equipment

Rubber Insulating Equipment Voltage Requirements		
Class Designation	Maximum Line Voltage AC RMS	Color of Package Label
00	500	Beige
0	1,000	Red
1	7,500	White
2	17,000	Yellow
See NFPA 70E 130.7(C) for additional detail		



Arc Flash PPE Table

Protective Clothing - Site PPE Table	
Incident Energy Level	Minimum Protective Clothing and Equipment (Outer layer of clothing shall be rated equal to or above the level of available incident energy. See Note 3)
Up to 1.2 cal/cm ²	<ul style="list-style-type: none"> • Long Sleeve Shirt (<i>Non-melting or un-treated fiber / cotton</i>) • Pants (<i>Non-melting or un-treated fiber / cotton</i>) <p>Coveralls can be used in lieu of Shirt & Pants</p> <ul style="list-style-type: none"> • Heavy Duty Leather Gloves or Rubber Gloves w/ Leather Protectors (as required) <p>Base PPE: Hard Hat, Safety Glasses, Earplugs (Ear canal inserts), Leather Footwear (Boots)</p> <p>Consider: Arc Rated Faceshield as required</p>
1.3 – 12 cal/cm ²	<p>Arc Rated Clothing Rated Above the Calculated Incident Energy Listed on the Electrical Hazard Label:</p> <ul style="list-style-type: none"> • Arc Rated Long Sleeve Shirt • Arc Rated Pants <p>Coveralls can be used in lieu of Shirt & Pants</p> <ul style="list-style-type: none"> • Arc Rated Flash Suit Jacket • Arc Rated Flash Suit Pants • Up to 4 cal/cm² Arc Rated Face Shield • 4.1 to 12 cal/cm² Arc Rated Flash Suit Hood or Arc Rated Face Shield and Arc Rated Balaclava • Heavy Duty Leather Gloves or Rubber Gloves w/ Leather Protectors (as required) <p>Base PPE: Hard Hat, Safety Glasses, Earplugs (Ear canal inserts), Leather Footwear (Boots)</p>

Arc Flash PPE Table

Protective Clothing - Site PPE Table	
Incident Energy Level	Minimum Protective Clothing and Equipment (Outer layer of clothing shall be rated equal to or above the level of available incident energy. See Note 3)
12.1 – 40 cal/cm ²	<p>Arc Rated Clothing Rated Above the Calculated Incident Energy Listed on the Electrical Hazard Label. <i>If mobility and dexterity is not an issue, use Arc Rated Clothing Meeting a minimum of 40 cal/cm²:</i></p> <ul style="list-style-type: none"> • Arc Rated Long Sleeve Shirt • Arc Rated Pants <p>Coveralls can be used in lieu of Shirt & Pants</p> <ul style="list-style-type: none"> • Arc Rated Flash Suit Jacket • Arc Rated Flash Suit Pants • Arc Rated Flash Suit Hood • Heavy Duty Leather Gloves or Rubber Gloves w/ Leather Protectors (as required) <p>Base PPE: Hard Hat, Safety Glasses, Earplugs (Ear canal inserts), Leather Footwear (Boots)</p>
Above 40 cal/cm ²	<p>Energized work for Equipment labeled with Incident Energies in excess of 40cal/cm² shall NOT be permitted.</p> <p>Operation of Equipment labeled with Incident Energies in excess of 40cal/cm² must be addressed on a case-by-case basis (<i>this Job Aid does NOT address this situation</i>).</p>

PPE



General requirements of PPE

- . Face shields shall have wraparound guarding to protect not only the face but also the forehead, ears, and neck. Alternatively an Arc Rated Flash Suit Hood can be worn.
- . If Rubber Insulating Gloves with Leather Protectors are used for protection against the shock hazard, additional Leather or Arc Rated Gloves are not required.
- . Unless layering has been certified by the manufacturer, the outer layer of clothing must be rated above the Incident Energy the individual could be exposed to performing the task at hand.
- . All outer layers of clothing within the Arc Flash Boundary must be Arc Rated, and NOT merely listed as fire retardant or fire resistant.
- . All body parts within the Arc Flash Boundary must be protected by Arc Rated protective clothing. All potentially exposable skin shall be covered.
- . An Arc Rated Jacket, Parka, Rainwear, or Hard Hat Liner can be added as needed.
- . Conductive articles of clothing and jewelry (including metalized aprons, cloth with conductive thread, and metal headgear) may NOT be worn within the restricted approach boundary.

Rubber protective equipment

Rubber protective equipment must be properly stored and inspected before and after each use.

The working area of the glove is limited to the area from the wrist of the glove to the fingers. The gauntlet is there for incidental contact only.

Rubber insulating gloves should be cleaned by the use of a manufacturers approved cleaning solution, rinsing with distilled water and air drying.

Store gloves gauntlet down in a rubber glove bag to prevent damage.

Rubber gloves should be replaced or dielectrically tested at intervals not to exceed six months.

Never use petroleum based talcum or baby powder when putting gloves back on since it could cause damage, and may also be conductive.

If the construction of equipment or type of work to be done on 120 Volt circuit or equipment is such that, in the Electrically Qualified Person's judgment, there is a potential or possibility of contact with the live conductor or component, a minimum of Class 00 gloves shall be used for the protection of the worker

Always Take the right body position

Properly Operating A Breaker And /Or An Overload:

- Always stand to the side of the starter cabinet and turn your head away from the cabinet and take a deep breath, before operating breaker or pushing the heater reset button. Arc Flash Clothing requirements is according to the PPE Table.



Summary

Hazards

- Inadequate wiring
- Exposed electrical parts
- Wires with bad insulation
- Ungrounded electrical systems and tools
- Overloaded circuits
- Damaged power tools and equipment
- Using the wrong PPE and tools
- Overhead power-lines
- All hazards are made worse in wet conditions

Protective Measures

- Proper grounding
- Using GFCI's
- Using fuses and circuit breakers
- Guarding live parts
- Proper use of flexible cords
- Training
- Arc flash PPE
- Arc flash procedure